

PARTIAL ENGLISH TRANSLATION OF JAPANESE LAID-OPEN  
PATENT APPLICATION NO.7-307166 (PARAGRAPHS 0011-0014,  
0019 & 0020):

5 [0011]  
[Embodiments]

In the following, embodiments of the  
present invention are described referring to  
attached drawings. Fig. 1 is a circuit diagram of a  
secondary battery according to an embodiment of the  
10 present invention. With reference to Fig. 1, a  
battery pack 1 includes a secondary battery 2  
(simply called "battery" in the following) such as a  
nonaqueous electrolyte second battery, and a  
15 thermistor 3 that is arranged near the battery 2 for  
temperature measurement in a cabinet. Fig. 1 shows a  
state wherein a charging unit 4 is attached to the  
battery pack 1. Here, the charging unit 4 may be  
attached to an apparatus such as a portable  
20 telephone in which the battery pack 1 is installed.  
[0012]

The charging unit 4 is configured as  
follows. To the charging unit 4, a DC voltage, e.g.  
+12 V, is provided from an external DC supply  
25 source; the DC voltage flows through a filter 5 for  
noise removal, and smoothed by a smoothing condenser  
6. Further, the DC voltage output from the filter 5  
is precisely stabilized by a regulator 7 to +5 V,  
and provided to a micro controller 8.  
30 [0013]

Further, a positive output terminal of the  
filter 5 is connected to a terminal of a switching  
transistor 9 consisting of a power MOS transistor.  
The switching transistor 9 is switching-controlled  
35 by a pulse signal from an output terminal D of a PWM  
(pulse width modulation) circuit 10. The voltage  
switched by the switching transistor 9 is smoothed

by a diode 11, a choke coil 12, and a smoothing condenser 13; and provided to a positive terminal of the battery 2 as a charging voltage VB through a diode 14 for backflow prevention.

5 [0014]

A resistor 15 for detecting a charging current is connected between a negative terminal of the battery 2 and a negative output terminal of the filter 5. Further, two resistors 16, and 17 for  
10 detecting a charging voltage are serially connected between an output terminal of the smoothing circuit (including the diode 11, the choke coil 12, and the condenser 13) and the negative output terminal of the filter 5. A terminal voltage of the resistor 15,  
15 which voltage is in proportion to the charging current, and a voltage at a junction point A, where the resistors 16, and 17 are connected, which voltage is in proportion to the charging voltage are provided to an input terminal F of the PWM circuit  
20 through diodes 18, and 19, respectively. A grounding terminal G of the PWM circuit 10 is connected to the negative terminal of the filter 5, and a starting terminal S of the PWM circuit 10 is connected to a port P0 of the micro controller 8. The PWM circuit  
25 10 is started by an "H" level signal provided to the starting terminal S, and outputs from the output terminal D a pulse signal that has a pulse width that is in reverse proportion to the voltage provided to the input terminal F.

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[0019]

In the following, charging operations according to the present embodiment are described. When the battery pack 1 is attached to the charging  
35 unit 4, the micro controller 8 recognizes that the battery pack 1 is attached by a change of a thermistor voltage Vt from Vcc=+5 V to, e.g., 2.5 V

(equivalent to when the temperature of the battery 2 is 20 degrees C). Further, the voltage determining unit 33 of the micro controller 8 determines whether the battery voltage VB is within a range of

5     $5.0V \leq VB \leq 8.6V$  based on an output digital value of the A/C converter 32. If the VB is within the range, it is determined that the battery 2 is normal, the switch 34f is turned off by the switch control circuit 33, and the port P0 is changed from "L"

10 level to "H" level.

[0020]

In this way, the PWM circuit 10 is started. The PWM circuit 10 outputs a pulse from the output terminal D, the pulse having a pulse width that is

15 in reverse proportion to the voltage provided to the input terminal F; and the pulse serving as the switching pulse is provided to the gate of the switching transistor 9. When the switching transistor 9 is turned on by the switching pulse,

20 the DC voltage output from the filter 5 flows through the switching transistor 9, is smoothed by the diode 11, the choke coil 12, and the condenser 13, and then provided to the positive terminal of the battery 2 through the diode 14 for backflow

25 prevention as the charging voltage VB such that charging is carried out.